Soyuz 10 Return Samples: Assessment of Air Quality Aboard the International Space Station

The toxicological assessments of 4 dual sorbent tubes (DSTs) and 4 pairs of formaldehyde badges returned aboard Soyuz 10 on October 10, 2005 are reported. Analytical methods have not changed from earlier reports. The recoveries of the 2 less volatile surrogates from the DSTs (including controls) averaged 100 and 100 %; however, ^{13}C-acetone was only recovered at an average of 60 %. Correction factors were applied to volatile polar compounds due to limited recoveries by the DSTs. Formaldehyde recoveries from 2 positive controls were 97 and 74%.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO_2 and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers, hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from sorbent badges, its concentration is also listed separately. These four indices of air quality are summarized below:

Module/Sample	Approx. Date	NMVOCs (mg/m^3)	T Value (units)	Alcohols (mg/m^3)	Formaldehyde (ug/m^3)
Lab/DST&Form.	9/8/05	25	3	16[2]	46[3]
SM/DST&Form.	9/8/05	2	0.2	1	25
FGB/DST&Form.	9/30/05	4	1.2	2	26
SM/DST&Form.	9/30/05	1	0.1	1	19
Guideline		*<25*	*<1.0*	*<5*	*<120*[1]

[1] A new long-term SMAC has been provisionally accepted by the National Research Council Committee on Toxicology and by the NASA Toxicology Group.
[2] Ethanol contributed 10 mg/m^3 to this value.
[3] Counted as an irritant (formaldehyde T value = 46/120 = 0.38).

All formaldehyde concentrations were well within the new long-term SMAC guideline. The Lab samples continue to show slightly higher formaldehyde concentrations than the SM/FGB samples. The Lab sample from September 8th showed unusually high alcohols and a high T value. Ethanol can be episodically high in specific locations, and this comprised most of the elevated total alcohol value. The T value was elevated mostly by methanol (0.28), acetaldehyde (0.99), and traces of acrolein (0.5), methyl furan (0.27), and furan (0.5); however, the low T value found simultaneously in the SM argues that the levels of pollution found in the Lab sample were not widespread in the ISS. One “dirty” sample such as this does not cause any concern for crew health. The T value for irritants (acetaldehyde, acrolein, and formaldehyde) was 1.9, suggesting that the crew might have experienced momentary, mild eye or nasal irritation from the atmospheric contaminants.

Enclosures

Table 1: Analytical Concentrations of 10S DST Air Samples
Table 2: T-Value Calculations of 10S DST Air Samples